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FUTURE VISIONS OF INTEGRATED PEST MANAGEMENT (IPM) FOR MAIZE CROPS IN ROMANIA

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Abstract

Integrated pest management (IPM) has the potential to help farmers minimize the use of crop protection chemicals, relying primarily on preventive measures, reducing costs, and contributing to the transition to sustainable food systems. Although IPM approaches have been developed for a wide variety of crops and contexts, their adoption by farmers remains low across Europe. Previous studies show that farmers prefer a certain agricultural system due to socio-economic dependencies or support and support policies, market or conditions related to equipment and infrastructure, farm machinery and equipment, or insufficient professional training. This suggests that many farmers cannot simply adopt IPM and that changes and clarifications are needed along the entire chain from production, distribution, processing, market, and consumption to agricultural policy levels. This paper presents some of the results obtained to contribute to a greater extent to the co-creation of policies and actions together with the actors involved, regarding consumer health, plant and animal welfare, conservation and protection of the environment and biodiversity, adaptation of plant cultivation technologies to the effects of climate change.

Key words*: Integrated Pest Management, IPM, maize, future vision, conventional farming, organic farming.*

INTRODUCTION

Current EU legislation, such as the Sustainable Use of Pesticides Directive (SUD) and the European Green Deal, are part of a wider strategy to reduce reliance on chemical pesticides for agriculture production. Integrated Pest Management (IPM) emerged as a pest control framework promoting sustainable intensification of agriculture, by adopting a combined strategy to reduce reliance on chemical pesticides while improving crop productivity and ecosystem health (Zhou et al., 2024). Although IPM approaches have been developed for a wide diversity of crops and contexts, their uptake by farmers remains low across Europe (https://he-support.eu/). Earlier studies show that farmers sometimes feel stuck in a specific farming system due to economic dependencies and the lack of collectively sharing transition risks, among other issues (Hoes et al., 2023; Meuwissen et al., 2020; Siebrecht, 2020; Vermunt et al., 2022; Vrolijk et al., 2020). This suggests that many farmers cannot simply adopt IPM, necessitating changes to be made at the supply chain (processing, distribution, and consumption) and policy levels as well (Hoes, 2024).

Intense long-term utilization of pesticides on cultivated area causes substantial environmental and health concerns (Aktar et al., 2009). As a pollutant, when applied on ground, pesticides are able to disturb the soil properties because of its contaminant effect and harmful impact on biodiversity. Over entire pesticides utilized for crops, it has been stated that an extremely small percent reaches the target organism whereas the residues of it pollute the surrounding field (air, water, and ground). All these aspects require a permanent monitoring in order to avoid a series of imminent dangers (Dragomir Bălănică et al.,

2024). Adopting good agricultural practices, especially on the soil management, is a key factor in granting food, clean water, feed, energy, safe climate, diverse ecosystem services and biodiversity etc. for future generations (Musat et al., 2021).
From the point of view of farmers' attitude towards these challenges, sometimes there are certain limits in reducing the application of pesticides in agriculture (Chèze et al., 2020), and as a perspective it is difficult to obtain food to feed more than 9 billion people until 2050, without the application of these products. Plant protection products are a substantial part of modern day agriculture (Ganchev, 2022).
On the other hand, maize crops around the world are an important source of food production for both humans and animals (Erenstein et al., 2022), and also in Romania, where the surface oscillates annually between 2.1-2.5 million ha. This is the reason why, in the case of the Support project (Supporting Uptake Integrated Pest Management and Low-Risk Pesticide Use) (https://he-support.eu/), within the Horizon Europa program (HORIZON-CL6-2022-FARM2FORK-01), for Romania the assigned National Cluster Crop is maize for the analysis of current and future IPM practices.

MATERIALS AND METHODS

This study presents the opinion of farmers and other target groups (researchers, input suppliers, consultants, decision-makers, etc.), regarding the perspectives and future visions of the implementation and adoption of IPM strategies for maize crops in Romania.
Two co-creation workshops took place as part of Support project activities in Romania, organised by University of Agronomic Sciences and Veterinary Medicine of Bucharest (USAMV of Bucharest) and the Forum of Professional Farmers and Processors from Romania (FAPPR), partners within this project. These co-creation workshops applied a backcasting approach (Hoes, 2024). Backcasting involves developing a desirable future vision and exploring which changes are needed in the present to move closer towards this goal (Vergragt & Quist, 2011).
50 people participated in these actions, including farmers, researchers, consultants, experts, distributors of agricultural inputs, authorities.
The two working groups drew up the future visions of IPM in maize crops, both for the conventional system and for the organic agriculture system (Figure 1).

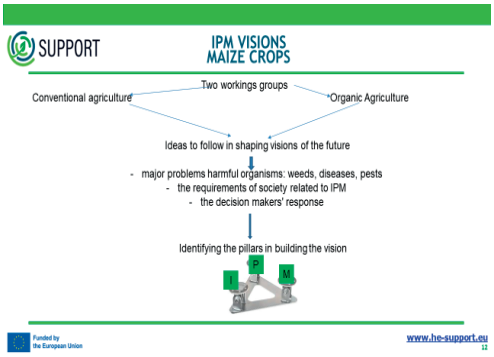

Figure 1. Methodology of the workshops organization

The answers were followed through the prism of three dimensions, namely: major problems due to harmful organisms, weeds, diseases and pests of maize crops; the requirements of society; the response of the authorities. Starting from the three dimensions, the pillars on which the IPM vision is to be based were finally identified.

RESULTS AND DISCUSSIONS

Farmers, policy makers and other actors need reliable data and information in order to make sound decisions about crop protection and crop protection policy. This requires a clear understanding of the existing crop protection practices in different crops across the EU, as well as their environmental, social and economic impacts. This also necessitates an overview of potential IPM practices that can be applied in different crops and regions and the potential gains in terms of the environmental, social and economic impacts (https://he-support.eu/).
IPM can include modern agricultural technologies, communication tools based on sustainability principles, but also on traditional methods, integrating human, environmental, social and economic factors in food production (Xu et al., 2024).

Farmers' access to alternative methods and lower-risk products could help them apply Integrated Pest Management in maize crops (https://op.europa.eu/webpub/eca/special-reports/pesticides-5-2020/en/).
The Agricultural Policy can help support the sustainable use of plant protection products, for example through financial support for measures such as organic farming and environmental schemes (https://agriculture.ec.europa.eu/sustainability/environmental-sustainability/cap-and-environment_en).
Facilitating the use of alternative methods and access to lower-risk products can help support a more sustainable pest management process (https://www.eca.europa.eu/lists/ecadocuments/sr20_05/sr_pesticides_en.pdf).
Research and innovation activities are important to ensure that alternative pest management methods and low-risk products are available to enable the implementation of IPM (https://www.eca.europa.eu/lists/ecadocuments/sr20_05/sr_pesticides_en.pdf).

The vision of IPM in the maize crop in conventional farming system, in Romania
According to current statistics, the maize crop in Romania continues to be of major importance, even if in recent years, due to less favourable climatic conditions, the maize production has suffered greatly from drought.
This has led to a reduction in total production, from over 14.8 million tonnes to only 8 million tonnes (Table 1).

Table 1. Current status of maize crops in Romania (MADR, 2024)

Year	Area (ha)	Average production (kg/ha)	Total production (tons)
2015	2,605,165	3,462	9,021,403
2016	2,580,975	4,159	10,746,387
2017	2,402,082	5,959	14,326,097
2018	2,439,842	7,644	18,663,939
2019	2,678,504	6,502	17,432,223
2020	2,537,104	3,977	10,096,689
2021	2,549,281	5,802	14,820,693
2022	2,431,106	3,298	8,037,134
2023	2,195,344	3,982	8,743,995

From the point of view of problems due to harmful organisms, the following can be summarized:

- In the future, maize crop will be greatly influenced by climatic conditions, and drought can be a limiting factor, both in terms of production and its quality, increasing the variability in time and space of maize production.
- In drought-affected areas, farmers who will not be able to irrigate will reduce their maize area or stop growing maize, while farmers who will be able to irrigate will increase their maize area, which will be of interest from the economic point of view.
- The tendency will be to concentrate the cultivation of maize in the areas where it will be irrigated. As a result, maize hybrids more tolerant to climatic conditions will be obtained.
- Due to the fact that some pesticides will disappear from the market, harmful organisms will develop resistant breeds, and there is a risk that the accepted pesticide products will no longer have the same effectiveness, while they will have higher costs.
- The number of control treatments will depend on the virulence with which the maize plants will be attacked.
- Maize will be a profitable crop, through the range of products resulting from its processing.
- New technologies will be more expensive, and the implementation cost will be higher and this will be reflected in the price of the final product.
- The effect of different tillage options, with positive and negative effects on harmful organisms, must be taken into account.
- Thus, in the variants of minimal tillage and the variant without tillage there can be a lower degree of weeding through the germination of seeds, seeds that remain on the surface of the soil, without being incorporated into the soil where they can germinate and give rise to weeds, while the species of perennial weeds can proliferate. Also in these systems, maize plants can be more exposed to disease and pest attack (for example, the attack of rodents is intensified, especially when the soil is no longer tilled or the entire surface is no longer tilled or in depth).
- Drip irrigation, mulching will be widely adopted.

From the point of view of society's requirements, the following can be summarized:

- Society sees pesticides as something bad. It also tends to place the onus entirely on farmers, without understanding and accepting that reducing pesticide use will come with a number of additional costs to farmers, which will mean more expensive final products.
- Society will want cheap products that will provide daily food. As such, social perception will have to be improved, in this sense, the mass media having an important role, having to provide correct information to society.

From the point of view of the answers of the authorities, the following can be summarized:

- From a legislative point of view, new, stricter rules will be imposed on the use of pesticides.
- These regulations are perceived to be increasingly less farmer friendly. There is a need for clearer and more accurate official communication.
- Technologies that are gentler on the environment will continue to be supported.

The main constraints and opportunities for applying IPM to maize crops in Romania are presented in Figures 2 and 3.

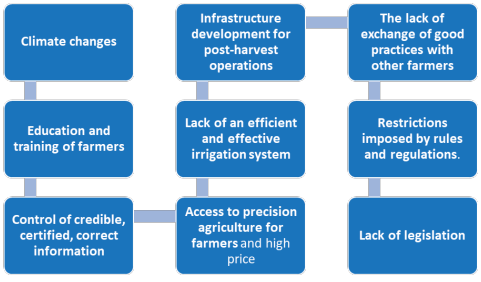

Figure 2. Main constraints for applying IPM to maize crops in Romania

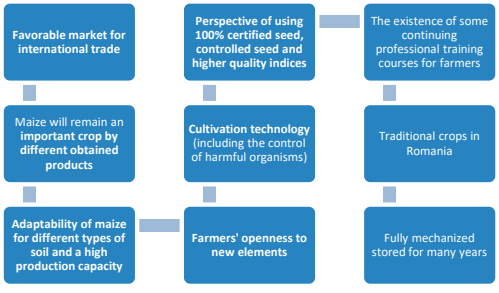

Figure 3. Main opportunities for applying IPM to maize crops in Romania

The vision of IPM in maize crop in organic farming.

In the organic farming, strict rules must be followed regarding the use of plant protection products. As a result, the control over IPM will largely depend on the rules imposed by the related legislation.

According to FiBL statistics, of the 579 thousand ha occupied by agricultural land managed in an organic system in Romania, over 35.5 thousand ha are cultivated with maize.

Table 2. Current area of organic maize crops in Romania (https://statistics.fibl.org/, 2024)

Year	Area (ha)	Maize area (ha)
2015	245,924.00	23,137.00
2016	226,309.00	16,643.00
2017	258,471.00	19,671.00
2018	326,260.00	26,745.00
2019	395,228.00	36,720.00
2020	468,887.00	40,164.00
2021	578,718.00	35,576.00
2022	644,520.00	35,576.00

From the point of view of problems due to harmful organisms, the following can be summarized:

- It is believed that due to future climate changes and global warming, maize hybrids will appear more tolerant and resistant to environmental conditions, as well as to the attack of harmful organisms.
- Of course, there will be the risk of the appearance of new organisms harmful to maize, with a much greater intensity and frequency of attack. As a result, the new technology will be based on the use of precision agriculture, drones and robots, which will help to predict the action of harmful organisms, and through information systems, IT, technology, farmers will be instantly warned by phone about the risk of the appearance of a pest or pathogen. They will know exactly when to act and will use small amounts of biopesticides, which will contribute to ensuring the economic efficiency of the farmers' activity, which will protect the health of consumers and the environment.
- The soils will be balanced from a microbiological point of view, based on conversion periods that will be more effective

both in terms of duration and intensity for the transition from conventional to organic farming. This will translate into lower risks due to harmful organisms.
- The personnel who will work in precision agriculture will need to be trained and trained, and funds will be needed that will be used for this purpose.
- Plant protection products will be based more on plant physiology and will be applied exactly when harmful organisms are most sensitive.
- Drip irrigation, mulching will be widely adopted.
- There will be databases in the mother tongue, which will be made available to farmers to better know the biology and the way of attack and methods of controlling pests, diseases and weeds so that the best method suitable for the concrete conditions of the respective farm.
- The products allowed in organic agriculture to control weeds will remain a problem for the maize crops, having limits imposed by the legislation.

From the point of view of society's requirements, the following can be summarized:
- The consumers will continue to appreciate organic maize products. However, the price will remain high for these products. Throughout the chain, these products will have to be promoted, and education and professional training will have a major role.
- Legislation and control will have to take into account all actors in the chain, so as to improve consumer confidence in this product.
- The safety and traceability will guarantee the facilitation of the export of products.

From the point of view of the answers of the authorities, the following can be summarized:
- The authorities will have to respond to the demands of society.
- The safety of traceability must be ensured by legislation and product controls throughout the chain.

Farmers, policy makers and actors need reliable data and information in order to make sound decisions about crop protection and crop protection policy. This requires a clear understanding of the existing crop protection practices in different crops across the EU, as well as their environmental, social and economic impacts.

The main constraints and opportunities for applying IPM to organic maize cultivation in Romania are presented in Figures 4 and 5.

This also necessitates an overview of potential IPM practices that can be applied in different crops and regions and the potential gains in terms of the environmental, social and economic impacts. Support project proposes the application of indicators reflecting the economic, social and environmental impacts of crop protection, which enables them to make their crop protection more sustainable.

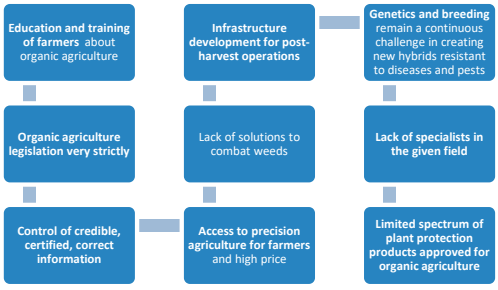

Figure 4. Main constraints for applying IPM to organic maize crops in Romania

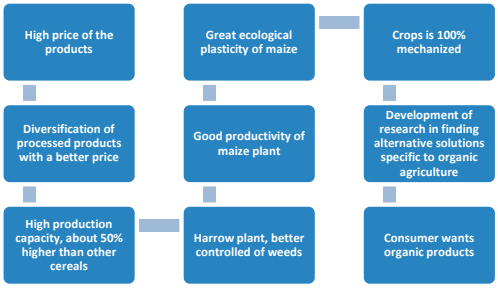

Figure 5. Main oportunities for applying IPM to organic maize crops in Romania

CONCLUSIONS

The health of crops and soil, of the environment in general, is threatened by numerous harmful species that can represent a major risk for agricultural production, for food security and safety at the global level.

Integrated measures to prevent and preserve crop health and Integrated Pest Management (IPM) have become an important topic in agricultural policies worldwide, in Europe, but also in Romania.

IPM can include modern agricultural technologies, communication tools based on sustainability principles, but also on traditional methods, integrating human, environmental, social and economic factors in food production. Consumers will continue to want safe products, without residues, which is why a stable and fair market will be developed for the sale of these products.

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